

# Relation Between Optimism and Lipids in Midlife

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The present research examined optimism's relation with total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides. The hypothesis that optimism is associated with a healthier lipid profile was tested. The participants were 990 mostly white men and women from the Midlife in the United States study, who were, on average, 55.1 years old. Optimism was assessed by self-report using the Life Orientation Test. A fasting blood sample was used to assess the serum lipid levels. Linear and logistic regression models examined the cross-sectional association between optimism and lipid levels, accounting for covariates such as demographic characteristics (e.g., education) and health status (e.g., chronic medical conditions). After adjusting for covariates, the results suggested that greater optimism was associated with greater high-density lipoprotein cholesterol and lower triglycerides. Optimism was not associated with low-density lipoprotein or total cholesterol. The findings were robust to a variety of modeling strategies that considered the effect of treatment of cholesterol problems. The results also indicated that diet and body mass index might link optimism with lipids. In conclusion, this is the first study to suggest that optimism is associated with a healthy lipid profile; moreover, these associations can be explained, in part, by the presence of healthier behaviors and a lower body mass index. © 2013 Elsevier Inc. All rights reserved. (Am J Cardiol 2013;111:1425–1431)

The present study investigated a cardiovascular risk factor that has yet to be empirically investigated in relation to optimism—namely, serum lipids. Optimism and lipid levels were expected to be associated because lipid profiles are driven in part by health behaviors and optimism has been linked to healthier behaviors, such as eating a balanced diet, exercising, and consuming moderate amounts of alcohol.<sup>1–4</sup> We hypothesized that greater levels of optimism would be associated with a healthier lipid profile (i.e., more high-density lipoprotein [HDL] cholesterol and less total cholesterol, low-density lipoprotein [LDL] cholesterol, and

triglycerides), controlling for potential confounders (i.e., demographic characteristics and health status). Moreover, we hypothesized that the association between optimism and the lipid levels would be partially explained by healthier behaviors, such as moderate alcohol consumption, exercise, diet, and the absence of cigarette smoking. To investigate these hypotheses, we conducted cross-sectional analyses of data from men and women included in the Midlife in the United States (MIDUS) study.

## Methods

The MIDUS study was started in 1995 to better understand the connections among psychosocial factors, aging, and health in men and women aged 25 to 74 years. More than 4,000 subjects were first recruited by either random digit dialing or oversampling select metropolitan areas.<sup>5</sup> Twin pairs and  $\geq 1$  siblings of randomly selected participants were recruited when possible, resulting in a total baseline sample of 7,108. A longitudinal follow-up assessment comprised of 5 distinct projects was initiated 9 to 10 years later. The present investigation included a subsample of respondents from the longitudinal follow-up who had completed the psychosocial and biomarker projects. The psychosocial project, which entailed a telephone interview and self-administered questionnaires, was completed by 5,895 of the original 7,108 participants and included measures of optimism and demographic factors. The participants who completed the psychosocial project and who were healthy enough to travel to a research clinic were eligible for the biomarker project, which was conducted an average of  $26 \pm 14.66$  (SD) months later (range 2 to 62). The biomarker project was an in-depth, multiday assessment with an overnight stay that yielded measures of lipids, health

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Support for this research was provided by the Robert Wood Johnson Foundation through the grant, "Exploring the Concept of Positive Health," to the Positive Psychology Center of the University of Pennsylvania, Martin Seligman, project director (Philadelphia, Pennsylvania). The original Midlife in the United States study was supported by the John D. and Catherine T. MacArthur Foundation Research Network on Successful Midlife Development (Chicago, Illinois). Follow-up data collection was supported by grant P01-AG020166 from the National Institute on Aging, National Institutes of Health (Bethesda, Maryland).

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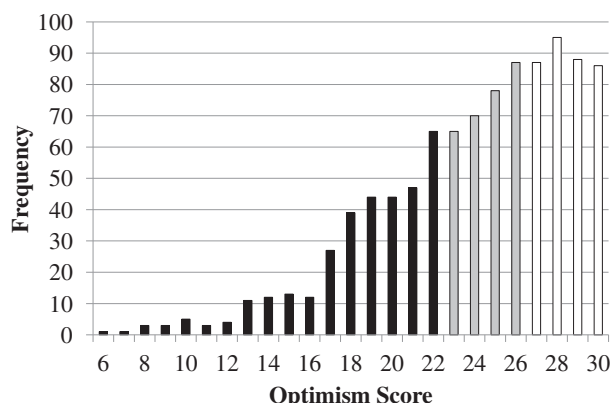


Figure 1. Frequency distribution of 990 optimism scores (mean  $\pm$  SD  $23.95 \pm 4.69$ ), with *black* representing lowest tertile of optimism (6 to 22), *gray*, middle tertile of optimism (23 to 26), and *white*, highest tertile of optimism (27 to 30).

status, and health behaviors, among others. Because of the substantial commitment required, 1,255 of the 3,191 eligible men and women (39.3%) participated (43.1% participated after adjusting for those who could not be contacted or located).<sup>6</sup> Of the eligible participants, those who participated in the biomarker project did not differ from those who did not with regard to age, gender, race, marital status, income, chronic disease, or body mass index (BMI), but they were more highly educated.<sup>6</sup> Only participants with complete data on optimism, lipid levels, potential confounders, and pathway variables were included, yielding an analytic sample of 990. The appropriate institutional review boards approved the present research, and all participants provided consent.

The 6-item Life Orientation Test-Revised was used to assess optimism.<sup>7</sup> The participants indicated the extent to which they agreed (1, agree a lot; to 5, disagree a lot) with 3 positively worded items ("I expect more good things to happen to me than bad," "I'm always optimistic about my future," "In uncertain times I usually expect the best") and 3 negatively worded items ("I hardly ever expect things to go my way," "If something can go wrong for me it will," "I rarely count on good things happening to me"). Because optimism can best be characterized by endorsing both positively worded items and rejecting negatively worded items,<sup>8</sup> we followed the recommendations to use the 6-item composite rather than the 3-item subscales.<sup>9</sup> The positively worded items were reverse scored and added to negatively worded items to create a total optimism score ranging from 6 to 30 (Figure 1;  $\alpha = 0.82$ ). Higher values indicated more optimism, and the total score was standardized (mean  $0 \pm 1$ ) for greater interpretability.

The participants traveled to 1 of 3 clinical research sites for 2 days of biologic assessment. On the second morning of the visit, the participants provided a fasting blood sample for a lipid panel of total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides. The samples were initially stored in a  $-60^{\circ}\text{C}$  to  $-80^{\circ}\text{C}$  freezer at each site, and then frozen serum (1-ml aliquots) was shipped on dry ice to Meriter Laboratories (Madison, Wisconsin) and stored at  $-65^{\circ}\text{C}$ . All assays were performed with a Cobas Integra

analyzer (Roche Diagnostics, Indianapolis, Indiana). An enzymatic colorimetric assay was used for total cholesterol, HDL cholesterol, and triglycerides; LDL cholesterol was derived using the Friedewald calculation<sup>10</sup> (if the triglyceride levels were  $>400$  mg/dl, the observed values were replaced with 400 mg/dl to calculate the LDL cholesterol level). From the total biomarker project sample, the total cholesterol assays ranged from 0 to 800 mg/dl (reference range  $<200$ ); the interassay coefficient of variation (CV) was 1.4% to 1.9% and the intra-assay CV 0.5% to 0.8%. The HDL cholesterol assays ranged from 0 to 155 mg/dl (reference range 40 to 85); the interassay CV was 2.2% to 2.3% and intra-assay CV 1.1% to 1.5%. The triglyceride assays ranged from 0 to 875 mg/dl (reference range  $<150$ ); the interassay CV was 1.9% and intra-assay CV 1.6%. The LDL cholesterol interassay CV was 10.11% (reference range 60 to 129 mg/dl).

The analyses were controlled for factors known to be associated with the lipid profiles. The demographic data were self-reported and included age (in years), gender, race (white, nonwhite), education (less than high school degree, high school degree, some college, college degree or greater), household income, and months between the optimism and serum lipid assessments. Health status included chronic conditions (none or  $\geq 1$  condition) and blood pressure medication use (no, yes). The presence of chronic conditions (heart disease, hypertension, stroke, or diabetes) was assessed by the item "Have you ever had any of the following conditions or illnesses diagnosed by a physician?" Corticosteroids and depression medications were also considered but were not included in the final models because they were not associated with lipids in the age-adjusted regression analyses. The categorical variables were dummy coded before inclusion in the models.

To examine optimism's independent effects from psychological ill-being, negative affect was controlled in the secondary analyses. Negative affect was assessed during the psychosocial project using 5 items from a widely used and psychometrically valid scale.<sup>11</sup> The participants indicated the extent to which they felt afraid, jittery, irritable, ashamed, and upset in the previous 30 days (1, none of the time; to 5, all of the time). In accordance with previous work in the MIDUS study, an average score was calculated if  $\geq 1$  item was rated; higher scores reflected more negative affect.

Potential behavioral pathways included smoking status (current smoker, past smoker, never smoker), average number of drinks consumed/day in the past month, regular exercise  $\geq 3$  times/week for 20 minutes (no, yes), and prudent diet. Smoking status and exercise were dummy coded for statistical analysis. For diet, the participants indicated their consumption of food categories during an average day or week. Consistent with previous research,<sup>12</sup> a prudent diet score was calculated by giving the participants a point for consuming  $\geq 3$  servings/day of fruit and vegetables,  $\geq 3$  servings/day of whole grains,  $\geq 1$  servings/week of fish,  $\geq 1$  servings/week of lean meat, no sugared beverages,  $\leq 2$  servings/week of beef or high-fat meat, and food at a fast food restaurant less than once per week. The scores ranged from 0 to 7 (mean  $4.24 \pm 1.39$ ); higher scores indicated a healthier diet. Because BMI is a product of health behaviors and genetics, we also investigated its

Table 1  
Distribution of participant characteristics according to optimism level

Characteristic	Optimism			p*
	Low (n = 334)	Moderate (n = 300)	High (n = 356)	
Age (yrs)	53.13 ± 11.68	56.58 ± 12.36	55.75 ± 11.15	0.0005
Gender				0.33
Male				
Column %	48.50	44.67	42.98	
Row %	36.08	29.84	34.08	
Female				
Column %	51.50	55.33	57.02	
Row %	31.79	30.68	37.52	
Race				0.24
White				
Column %	91.62	95.00	93.26	
Row %	33.15	30.88	35.97	
Nonwhite				
Column %	8.38	5.00	6.74	
Row %	41.79	22.39	35.82	
Education				<0.0001
Less than a high school degree				
Column %	5.69	2.33	2.53	
Row %	54.29	20.00	25.71	
High school degree				
Column %	26.05	21.00	15.17	
Row %	42.65	30.88	26.47	
Some college				
Column %	32.34	28.67	25.56	
Row %	37.89	30.18	31.93	
College degree or more				
Column %	35.93	48.00	56.74	
Row %	25.75	30.90	43.35	
Income (United States dollars in thousands)	68.11 ± 54.32	75.58 ± 57.97	85.87 ± 65.12	0.0004
Interval between assessments (mo)	25.91 ± 14.64	26.15 ± 14.73	26.39 ± 14.66	0.91
Chronic conditions				0.74
Yes				
Column %	42.22	44.00	41.01	
Row %	33.65	31.50	34.84	
No				
Column %	57.78	56.00	58.99	
Row %	33.80	29.42	36.78	
Blood pressure medication				0.64
Yes				
Column %	33.83	37.00	33.99	
Row %	32.75	32.17	35.07	
No				
Column %	66.27	63.00	66.01	
Row %	34.26	29.30	36.43	
Body mass index (kg/m <sup>2</sup> )	29.71 ± 6.60	28.76 ± 5.51	28.91 ± 5.85	0.10
Smoking status				<0.0001
Current				
Column %	17.66	9.00	7.30	
Row %	52.68	24.11	23.21	
Past				
Column %	30.24	36.33	31.74	
Row %	31.27	33.75	34.98	
Never				
Column %	52.10	54.67	60.96	
Row %	31.35	29.55	39.10	
Alcohol consumption (drinks/day)	1.34 ± 1.40	1.10 ± 1.23	1.15 ± 1.39	0.06
Prudent diet	3.90 ± 1.45	4.29 ± 1.32	4.51 ± 1.33	<0.0001

(continued)

Table 1  
(continued)

Characteristic	Optimism			p*
	Low (n = 334)	Moderate (n = 300)	High (n = 356)	
Regular exercise				0.008
Yes				
Column %	74.25	84.00	80.62	
Row %	31.51	32.02	36.47	
No				
Column %	25.75	16.00	19.38	
Row %	42.36	23.65	33.99	
Negative affect	1.76 ± 0.61	1.48 ± 0.43	1.35 ± 0.34	<0.0001
Total cholesterol	198.15 ± 38.06	195.55 ± 38.29	196.08 ± 37.77	0.65
High-density lipoprotein cholesterol	52.29 ± 17.64	53.48 ± 16.55	56.26 ± 18.30	0.01
Low-density lipoprotein cholesterol	118.07 ± 35.55	114.42 ± 35.35	113.74 ± 34.93	0.23
Triglycerides <sup>†</sup>	140.53 ± 86.62	137.99 ± 88.74	128.47 ± 70.99	0.13

\* p Values from chi-square or analysis of variance tests.

<sup>†</sup> Before log transformation.Table 2  
Correlation coefficients for association between optimism and participant characteristics (n = 990)

Characteristic	Association With Optimism	
	r	p
Age	0.18	<0.0001
Gender*	0.02	0.49
Race <sup>†</sup>	-0.04	0.21
Education <sup>‡</sup>	0.18	<0.0001
Income	0.14	<0.0001
Interval between assessments	0.01	0.71
Chronic conditions <sup>§</sup>	0.003	0.93
Blood pressure medication <sup>  </sup>	0.03	0.43
Body mass index	-0.07	0.03
Smoking status <sup>¶</sup>	0.13	<0.001
Alcohol consumption	-0.07	0.03
Prudent diet	0.21	<0.0001
Regular exercise <sup>#</sup>	0.06	0.04
Negative affect	-0.45	<0.0001

\* Gender: men = 0, women = 1.

<sup>†</sup> Race: white = 0, nonwhite = 1.<sup>‡</sup> Education: less than high school degree = 1, high school degree = 2, some college = 3, college degree or more = 4.<sup>§</sup> Chronic conditions: no = 0, yes = 1.<sup>||</sup> Blood pressure medication: no = 0, yes = 1.<sup>¶</sup> Smoking status: 1 = current smoker, 2 = past smoker, 3 = never smoker.<sup>#</sup> Regular exercise: no = 0, yes = 1.

potential role as a mediator. BMI was measured by the clinical staff during the biologic assessment.

Statistical analyses were conducted using SAS, version 9.2 (SAS Institute, Cary, North Carolina). Given that treatment of cholesterol problems could bias the findings, previous work has routinely excluded participants who were receiving treatment. However, such an approach is not recommended because it discards relevant information, reduces power, and biases the parameter estimates.<sup>13</sup> Thus, in accordance with previous research, the lipid levels of

Table 3  
Unstandardized parameter estimates and 95% confidence intervals (CIs) for the association between one SD increase in optimism and lipid levels (n = 990)

Lipids (mg/dl)	Model 1*	Model 2 <sup>†</sup>
Total cholesterol	-0.64 (-3.11-1.83)	-0.61 (-3.09-1.86)
High-density lipoprotein cholesterol	1.32 <sup>‡</sup> (0.28-2.37)	1.21 <sup>§</sup> (0.18-2.25)
Low-density lipoprotein cholesterol	-1.18 (-3.47, 1.11)	-1.18 (-3.48-1.11)
Triglycerides (log transformed)	-0.03 <sup>  </sup> (-0.07-0.0009)	-0.03 <sup>  </sup> (-0.06-0.005)

\* Adjusted for demographics (age, gender, race, education, income, and interval between assessments).

<sup>†</sup> Adjusted for demographics and health status (chronic conditions and blood pressure medication).<sup>‡</sup> p ≤ 0.01.<sup>§</sup> p ≤ 0.05.<sup>||</sup> p ≤ 0.10.

those participants who were taking cholesterol medicine (n = 284) were corrected for the typical effect of such treatment.<sup>14-16</sup> That is, we increased the levels of total cholesterol by 20%, LDL cholesterol by 35%, and triglycerides by 15% and decreased the levels of HDL cholesterol by 5%. Because the distribution of triglyceride scores was skewed and kurtotic, the triglyceride scores were log transformed. The total cholesterol, HDL cholesterol, and LDL cholesterol levels had approximately normal distributions and were not transformed.

Each lipid served as an outcome in a series of linear regression models. The minimally adjusted model included demographic data (i.e., age, gender, race, education, income, and interval between the psychosocial and biologic assessments) and optimism as predictors. A second multivariable-adjusted model added health status (i.e., chronic conditions and blood pressure medication) to the first model. Sensitivity analyses examined whether the results differed when the (1) original lipid scores for all participants were maintained, regardless of the use of cholesterol medication

Table 4

Change in the association between optimism and lipid levels when potential pathway variables were included individually and all together in model 1\* (n = 990)

Predictors	HDL Cholesterol			Triglycerides (Log Transformed)		
	b	SE	%Δ	b	SE	%Δ
Optimism and demographics	1.32 <sup>†</sup>	0.53	—	−0.03 <sup>‡</sup>	0.02	—
+Prudent diet	0.86 <sup>‡</sup>	0.53	−35	−0.02	0.02	−32
+Exercise	1.21 <sup>§</sup>	0.53	−9	−0.03 <sup>‡</sup>	0.02	−10
+Smoking status	1.17 <sup>§</sup>	0.54	−12	−0.03 <sup>‡</sup>	0.02	0.2
+Alcohol consumption	1.39 <sup>‡</sup>	0.53	6	−0.03 <sup>‡</sup>	0.02	−4
+Body mass index	1.12 <sup>§</sup>	0.50	−15	−0.03	0.02	−21
+All pathway variables <sup>  </sup>	0.64	0.50	−52	−0.01	0.02	−54

\* Adjusted for demographics (age, sex, race, education, income, and interval between assessments).

<sup>†</sup> p ≤ 0.01.

<sup>‡</sup> p ≤ 0.10.

<sup>§</sup> p ≤ 0.05.

<sup>||</sup> Adjusted for demographics, prudent diet, exercise, smoking status, alcohol consumption, and body mass index.

(an approach in which the associations might be biased because of treatment), (2) participants taking cholesterol medication were excluded, and (3) the use of cholesterol medication was included as a covariate.

Additional models examined whether health behaviors and BMI were on the pathway between optimism and lipid levels in minimally adjusted models. However, because all data for relevant covariates were cross-sectional, we did not formally test mediation; thus, the direction of effects could be reversed. Instead, we examined how the regression coefficient for optimism changed when it was the sole predictor versus when a potential pathway variable was added to the model.<sup>17</sup> When the regression coefficient for optimism was reduced (indicated by a change of ≥10%) with the addition of a potential pathway variable, this suggested that the pathway variable partly explained optimism's association with lipids.

In the secondary analyses, negative affect was controlled for in the minimally adjusted models and also used to stratify the minimally adjusted models. We also conducted logistic regression analyses for each lipid to determine whether optimism was associated with the probability of being at high risk of unhealthy lipid levels (defined as taking cholesterol medication, diagnosis by a physician of cholesterol problems, or exceeding conventional cutpoints for having high [or in the case of HDL cholesterol, low] lipid levels). To account for the clustering of data because of the presence of sibling and twin pairs in the cohort, we reran the primary statistical analyses using generalized estimating equations. When the primary statistical analyses were conducted with generalized estimating equations, the results were nearly identical to those described. This suggested that the presence of clustering in the analytic sample did not bias the parameter estimates or standard errors. In the interest of interpretability, we have presented the findings from the primary statistical analyses. We also examined whether the

association between optimism and lipid levels differed by race, but no differences were evident (data not shown).

## Results

The participants were on average  $55.12 \pm 11.78$  years old (range 34 to 84). Men constituted 45% of the sample (n = 449) and women 55% (n = 541). The vast majority was white (93%; n = 923). The average lipid level was  $196.62 \pm 38.00$  mg/dl (first quartile 171.00; second quartile 194.40; third quartile 218.40) for total cholesterol,  $54.08 \pm 17.63$  mg/dl (first quartile 41.00; second quartile 51.64; third quartile 64.21) for HDL cholesterol, and  $115.41 \pm 35.28$  mg/dl (first quartile 91.12; second quartile 111.75; third quartile 136.00) for LDL cholesterol. The average triglyceride level was  $135.42 \pm 82.12$  (first quartile 81.00; second quartile 113.85; third quartile 166.00) before transformation. The distribution of covariates according to optimism level and correlations between optimism and covariates are listed in Tables 1 and 2. More optimistic subjects tended to be older, have greater education levels and income, engage in healthier behaviors, and report less negative affect compared to their less optimistic peers.

Optimism was not associated with LDL cholesterol and total cholesterol levels but was associated with HDL cholesterol and triglycerides in the expected directions (Table 3). For each SD increase in optimism, the HDL cholesterol levels were >1 mg/dl greater. For each SD increase in optimism, the triglyceride levels were 3% lower. These findings were only modestly attenuated after multi-variable adjustment.

When the original lipid scores were used without correcting for cholesterol treatment, the results were virtually identical to those after adjustment for the average effect of lipid medication (data not shown). Similarly, when examining the association between optimism and lipids among the 706 participants who were not taking cholesterol medication, the results were mostly indistinguishable. For example, among the participants not taking cholesterol medication, greater optimism was associated with greater HDL cholesterol levels (b = 1.39, 95% confidence interval [CI] 0.15 to 2.63, p = 0.03) and lower triglyceride levels (b = −0.04, 95% CI −0.08 to 0.002, p = 0.06) in minimally adjusted models. The findings were also nearly identical in models that controlled for cholesterol medication. For example, in minimally adjusted models, HDL cholesterol (b = 1.27, 95% CI 0.23 to 2.31, p = 0.02) and triglycerides (b = −0.03, 95% CI −0.06 to 0.003, p = 0.07) were still positively and inversely associated with optimism, respectively. Consistent with the models that adjusted for the typical effect of medication, LDL cholesterol and total cholesterol were not associated with optimism in any of the sensitivity analyses. Thus, the association between optimism and lipid profiles was robust, regardless of cholesterol treatment.

Because optimism was related to greater HDL cholesterol and lower triglyceride levels, we examined whether the associations might be explained by health behaviors and BMI (Table 4). Prudent diet, smoking status, and BMI reduced the relation between optimism and HDL cholesterol by >10%. When all health behaviors and BMI were included in the model simultaneously, the association between optimism and HDL cholesterol was reduced by



Table 5

Odds ratios and 95% confidence intervals (CIs) for the association between one SD increase in optimism and presence of unhealthy lipid levels\* (n = 990)

Lipids	Model 1 <sup>†</sup>	Model 2 <sup>‡</sup>
Total cholesterol	0.89 <sup>§</sup> (0.78–1.02)	0.91 (0.79–1.04)
High-density lipoprotein cholesterol	0.86 <sup>  </sup> (0.75–0.98)	0.88 <sup>§</sup> (0.76–1.01)
Low-density lipoprotein cholesterol	0.91 (0.79–1.04)	0.93 (0.81–1.07)
Triglycerides	0.87 <sup>  </sup> (0.76–1.00)	0.89 <sup>§</sup> (0.77–1.03)

\* Risk of unhealthy lipid levels was defined as taking cholesterol medication, physician diagnosis of cholesterol problems, or exceeding conventional cutpoints for unhealthy lipid levels (i.e., total cholesterol  $\geq 240$  mg/dl, HDL cholesterol  $< 40$  mg/dl for men and  $< 50$  mg/dl for women, LDL cholesterol  $\geq 160$  mg/dl, and triglycerides  $\geq 200$  mg/dl).

<sup>†</sup> Adjusted for demographics (age, gender, race, education, income, and interval between assessments).

<sup>‡</sup> Adjusted for demographics and health status (chronic conditions and blood pressure medication).

<sup>§</sup>  $p \leq 0.10$ .

<sup>||</sup>  $p \leq 0.05$ .

half, and the effect of optimism was no longer statistically significant. Prudent diet and BMI also reduced optimism's association with triglycerides. When all pathway variables were included in the model, the association between optimism and triglycerides was reduced by half.

When negative affect was included with optimism in the minimally adjusted models, the previously reported findings were slightly attenuated. Optimism remained associated with HDL cholesterol ( $b = 1.28$ , 95% CI 0.13 to 2.43,  $p = 0.03$ ), but negative affect was not ( $b = -0.20$ , 95% CI  $-2.48$  to 2.07,  $p = 0.86$ ). Optimism was not associated with triglycerides, but negative affect was (optimism,  $b = -0.01$ , 95% CI  $-0.05$ , 0.02,  $p = 0.45$ ; negative affect,  $b = 0.09$ , 95% CI 0.02 to 0.16,  $p = 0.02$ ). Neither optimism nor negative affect was associated with LDL cholesterol and total cholesterol. Furthermore, we also stratified these models by negative affect such that 58% of the sample was classified as having lower levels of negative affect and 42% as having higher levels. Among the participants with relatively lower levels of negative affect, optimism's association with HDL cholesterol ( $b = 2.66$ , 95% CI 1.05 to 4.26,  $p = 0.001$ ) and triglycerides ( $b = -0.07$ , 95% CI  $-0.12$  to  $-0.02$ ,  $p = 0.009$ ) paralleled the primary findings. The associations among the participants with relatively more negative affect were not statistically significant. The interaction term between optimism and negative affect was marginally significant for HDL cholesterol ( $p = 0.06$ ) and statistically significant for triglycerides ( $p = 0.009$ ).

In analyses modeling the risk of unhealthy lipid levels, the patterns were generally consistent. Controlling for confounding variables in the minimally adjusted and multivariable-adjusted models, a 7% to 14% reduction was found in the odds of having unhealthy lipid levels for every SD increase in optimism (Table 5). The findings were strongest for HDL cholesterol and triglycerides.

## Discussion

The present study investigated the cross-sectional association between optimism and lipids. Consistent with the

predictions, more optimistic attitudes were associated with higher HDL cholesterol and lower triglyceride levels. Specifically, for every SD increase in optimism, HDL cholesterol levels were 1 mg/dl higher and triglyceride levels 3% lower. The size of these associations was relatively small, although clinically significant. For example, a 1-mg/dl increase in HDL cholesterol is related to a 2% to 3% reduction in the risk of coronary heart disease.<sup>18</sup> The magnitude of the association between optimism and lipids is also comparable to the association between these lipids and health behaviors such as physical activity. Meta-analyses have shown that exercising can improve HDL cholesterol and triglyceride levels by 4% to 6%<sup>19</sup> or increase HDL cholesterol levels by 2.53 mg/dl.<sup>20</sup> Moreover, even small improvements at the individual level can translate into shifts in the distribution of risk at the population level.<sup>21</sup> Thus, our findings suggest that optimism could play a meaningful and nontrivial role in healthy lipid profiles.

Optimism was not associated with total cholesterol or LDL cholesterol. Although it is unclear why only HDL cholesterol and triglycerides were marginally or significantly related to optimism, such findings are consistent with research on other psychosocial factors.<sup>22</sup> For example, the personality traits of conscientiousness and impulsivity were more consistently associated with HDL cholesterol and triglycerides than with LDL cholesterol or total cholesterol.<sup>23</sup>

Optimism's association with HDL cholesterol and triglycerides was robust to alternative modeling strategies. The results did not measurably change when the lipid levels were adjusted for the typical effect of medication, when the lipid levels were based on the original unadjusted values, when the subjects taking cholesterol medication were excluded, or when demographics, health status, and cholesterol medication were controlled. The findings for triglycerides were somewhat attenuated when the analyses were adjusted for negative affect, but this could have resulted from the correlation between optimism and negative affect. However, optimism's association with HDL cholesterol and triglycerides was evident among participants with low negative affect. This suggests that optimism is not merely a proxy for the absence of distress but exhibits a monotonic relation with lipids across the score range. The findings were also maintained for the high-risk cutpoints.

The analyses also pointed to several behavioral pathways that could explain part of the observed association between optimism and a healthier lipid profile. Consistent with previous work, optimism was associated with smoking status, alcohol consumption, dietary intake, and exercise.<sup>1–4</sup> Adding prudent diet and BMI to the regression models noticeably attenuated optimism's association with HDL cholesterol and triglycerides. This suggests that optimistic individuals or people might be better equipped than their less optimistic peers to meet the challenges of engaging in healthy behavior and maintaining a healthy BMI.<sup>24</sup> However, rather than merely operating as a proxy for healthy behavior, optimism might serve as a precursor to healthy behavior by motivating persons to behave in ways that are consistent with their favorable expectations for the future. That is, expectations about the effects of a particular behavior both precede and influence the behavior itself, and

the expectations surrounding a behavior are separate from the behavior itself.<sup>25,26</sup> Health behaviors and BMI did not explain the entire association between optimism and lipids; thus, there are likely other relevant factors for explaining the optimism–lipid relation. For example, inflammation has been linked to both optimism<sup>27,28</sup> and metabolic dysfunction,<sup>29</sup> hinting that optimism might be associated with lipids through a direct inflammatory pathway.

A clear limitation of the present investigation was the cross-sectional data. Whether optimism leads to healthier lipid profiles or whether healthier lipid profiles (and better health in general) lead to optimism could not be determined, although optimism was often measured at least several months before the lipid profiles. Optimism did not vary substantially according to whether the participants were taking lipid medications, reducing somewhat the concern that lipid levels determine optimism. Although we suspect that optimism does influence lipid levels as an upstream determinant, it is also possible that the association is bidirectional. Moreover, an unmeasured third variable could also determine both optimism and lipid profiles. Future prospective and experimental research is needed to more clearly establish the direction of effects, to investigate whether associations differ depending on health status, and to examine whether controlling for other measures of ill-being alters the findings. The strengths of our research included a well-validated measure of optimism and objectively measured lipids, limiting concerns regarding self-report bias. Additional strengths included the ability to consider potential confounding and pathway variables. Taken together, the present research suggests that an optimistic outlook is related to a healthier lipid profile. Thus, considering optimism in the context of lipids could suggest new strategies for prevention and intervention to improve cardiovascular health.

**Acknowledgment:** We thank the research staff at Georgetown University (Washington, DC), University of Wisconsin-Madison (Madison, Wisconsin), and University of California, Los Angeles (Los Angeles, California).

## Disclosures

The authors have no conflicts of interest to disclose.

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